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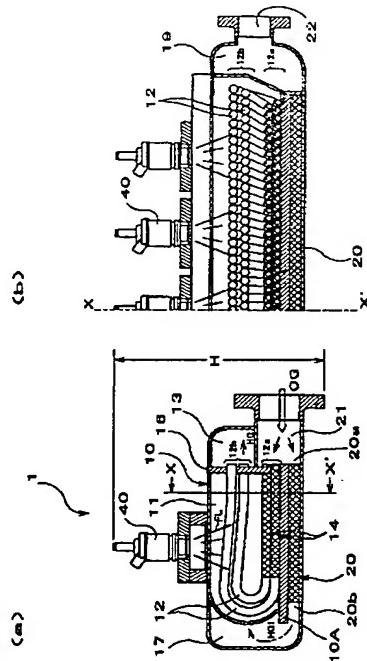
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(54)【発明の名称】 燃料蒸発器

(57)【要約】

【課題】 燃料蒸発器の高さを低くすることができ、かつ、触媒燃焼して発生した高温熱媒体の配管から系外への熱損失を少なくすることができる燃料蒸発器を提供することを目的とする。

【解決手段】 液体原燃料を蒸発させることができた高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブ12の中には、被燃焼体を燃焼させる触媒燃焼部14を備えることを特徴とする燃料蒸発器を解決手段とする。



## 【特許請求の範囲】

【請求項1】 液体原燃料を蒸発させることができ可能な高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブの中には、被燃焼体を燃焼させる触媒燃焼部を備えることを特徴とする燃料蒸発器。

【請求項2】 前記蒸発室に隣接する触媒燃焼器と、前記蒸発室が隣接した以外の部位に、前記液体原燃料を蒸発させた後の前記高温熱媒体が通流する高温熱媒体通路とを備えたことを特徴とする請求項1に記載の燃料蒸発器。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、燃料電池システムにおける液体原燃料の燃料蒸発器に関し、さらに詳しくは、蒸発室内の熱媒チューブの内側に被燃焼体を燃焼させる触媒燃焼部を備えた燃料蒸発器に関する。

## 【0002】

【従来の技術】燃料電池システムは、水素を燃料ガスとして燃料電池の水素極（陰極）に供給するとともに、酸素を含有する酸化ガスを燃料電池の酸素極（陽極）に供給して発電を行う燃料電池を中心とした発電システムである。この燃料電池システムは、化学エネルギーを直接電気エネルギーに変換するものであり、高い発電効率を有することや有害物質の排出量が極めて少ないと等から最近注目されている。

【0003】従来の燃料電池システムで使用される燃料蒸発器は、例えば特願平11-1253'66号に記載されている。この燃料蒸発器100は、図6に示すように、触媒燃焼器の中で、被燃焼体を触媒反応で燃焼させることにより発生させた高温熱媒体である燃焼ガスHGを、蒸発器本体110に導入するための入口部114と、前記燃焼ガスHGをU字形の熱媒チューブ112の入口部112aから出口部112bまでの内側に通流して、原燃料噴射装置140から前記熱媒チューブ112の外表面に噴射される液体原燃料FLを前記燃焼ガスHGから得られる熱により蒸発させる蒸発室111と、液体原燃料FLの蒸発を行った後の前記燃焼ガスHGが通流する蒸発室111の下面110Aに設けられる燃焼ガス通路113と、前記蒸発室111で蒸発した原燃料ガスFGを、前記燃焼ガス通路113を経由した燃焼ガスHGにより過熱するための過熱室132と蒸気チューブ131とから形成される過熱部130とから主要部が構成される。

【0004】以上から構成される従来の燃料蒸発器100の作用について述べる。図示しない触媒燃焼器で被燃焼体を燃焼させて生成した高温熱媒体である燃焼ガスHGは、蒸発器本体110の入口部114に導入される。入口部114に導入された燃焼ガスHGは、蒸発室111

1内のU字形をした熱媒チューブ112内の入口部112aから出口部112bまでを上から下に通過し、蒸発室111内で前記熱媒チューブ112の外表面に原燃料噴射装置140により噴射される液体原燃料FLを蒸発させる。次に、前記液体原燃料FLを蒸発させた後の燃焼ガスHGは、燃焼ガス通路113を経由して過熱部130の過熱室132へと導かれ、蒸発室111内で蒸発した原燃料ガスFGを蒸気チューブ131の外側からさらに過熱する。過熱された原燃料ガスFGは図示しない改質器へと導入され、原燃料ガスFGを過熱した後の燃焼ガスHGは排ガスとして系外に排出される。

【0005】しかしながら、従来の燃料蒸発器100は、図6に示すような、蒸発器本体110の蒸発室111の下面110Aに燃焼ガス通路113を設けたり、図示しない触媒燃焼器を蒸発室111の下面110Aに隣接して設けるため、燃料蒸発器100の全体の高さH1が高くなり、燃料電池システムを車両に搭載したときに、車高が高くなってしまうという問題があった。また、触媒燃焼器を蒸発室111の下面110Aに隣接して設ける場合に、触媒燃焼器の出口から蒸発室111内の熱媒チューブ112までの配管のところで系外への熱損失があり（温度降下 $\Delta T = 20 \sim 30^{\circ}\text{C}$ ）、せっかく触媒燃焼器で発生した高温の燃焼ガスHGの保有熱量が無駄になってしまうという問題があった。

## 【0006】

【発明が解決しようとする課題】本発明は、前記課題を解決するためになされたものであって、燃料蒸発器の高さを低くすることができ、かつ、触媒燃焼して発生した高温熱媒体の配管から系外への熱損失を少なくすることができる燃料蒸発器を提供すること目的とする。

## 【0007】

【課題を解決するための手段】前記課題を解決するための請求項1に記載された発明の要旨とするところは、液体原燃料を蒸発させることができ可能な高温熱媒体を通す熱媒チューブを備え、前記熱媒チューブから得られる熱により前記液体原燃料を蒸発させる蒸発室を有する燃料蒸発器において、前記熱媒チューブの中には、被燃焼体を燃焼させる触媒燃焼部を備えることを特徴とするものである。

【0008】蒸発室の熱媒チューブの内側に、触媒燃焼反応により被燃焼体を燃焼させる触媒燃焼部を設けて、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、従来、燃料蒸発器の前段に設けられていた触媒燃焼器の設置スペースを不要とし、燃料蒸発器全体の高さHを小さくできる。その結果、車両に燃料電池システムを搭載したときの車高を小さくすることができる。また、一体化した構成とすることにより触媒燃焼器から燃料蒸発器の熱媒チューブまでの配管から系外への熱損失がなくなる。

【0009】前記課題を解決するための請求項2に記載

された発明の要旨とするところは、前記蒸発室に隣接する触媒燃焼器と、前記蒸発室が隣接した以外の部位に、前記液体原燃料を蒸発させた後の前記高温熱媒体が通流する高温熱媒体通路とを備えたことを特徴とする請求項1に記載の燃料蒸発器である。

【0010】蒸発室の下面に隣接するように触媒燃焼器を設けて、蒸発室の加熱・保温用の高温熱媒体を発生させるだけでなく、蒸発室内の熱媒チューブ内の触媒燃焼部で発生した高温熱媒体を蒸発室の周囲に設けた高温熱媒体通路に通流させて、さらに蒸発室を加熱・保温することにより、速やかに蒸発が行われる。従って、触媒燃焼記および高温熱媒体通路を設けない場合と比較して、オフガスを触媒燃焼する量を少なくできるので、触媒装填量を減らすことができる。その結果、触媒燃焼器の高さを低くでき、全体として燃料蒸発器をコンパクト化することができる。

#### 【0011】

【発明の実施の形態】本発明に係る燃料蒸発器の実施の形態について図面を参照して説明する。図1は、本発明に係る燃料電池システムの全体系統図、図2(a)は、本発明に係る燃料蒸発器の側断面図、図2(b)は、図2(a)のX-X'断面図(左半分省略)、図3(a)は、本発明に係る触媒燃焼部の第一実施形態を示す横断面の斜視図、図3(b)は、本発明に係る触媒燃焼部の第二実施形態を示す横断面の斜視図、図4(a)は、本発明に係る触媒燃焼器の第一実施形態を示す横断面の斜視図、図4(b)は、本発明に係る触媒燃焼器の第二実施形態を示す横断面の斜視図、図4(c)は、本発明に係る触媒燃焼器の第三実施形態を示す横断面の斜視図、図5は、本発明に係る燃料蒸発器の燃焼ガス通路を示す斜視図である。

【0012】最初に、図1および図2を参照して本発明に係る燃料電池システムFCS全体について説明する。車両に搭載される燃料電池システムFCSは、蒸発器本体10の蒸発室11内に、その内側に燃料電池5のオフガスOGを触媒燃焼して発生した高温熱媒体である燃焼ガスHGを通流して外表面で接触する前記液体原燃料FLを蒸発させるU字形の熱媒チューブ12と前記熱媒チューブ12の内側に触媒燃焼部14とを備えた燃料蒸発器1と、前記燃料蒸発器1で前記液体原燃料FLを蒸発させて生成した原燃料ガスFGを、固体触媒上で反応させて燃料ガスにする改質器2と、前記改質器2で生成される前記燃料ガス中の一酸化炭素を除去するCO除去器3と、前記CO除去器3から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機4により圧縮された空気中の酸素とを反応させて発電を行う燃料電池5と、燃料電池5の水素極のオフガスOGから水分を分離・除去する気液分離装置6と、気液分離装置6から供給されるオフガスOGや補助燃料を燃焼して起動時等で燃料蒸発器1の加熱源となる高温熱媒体である燃焼ガスH

Gを発生する補助燃料(例えばメタノール)の供給ラインを有する燃焼バーナ7とを含んで構成される。

【0013】前記のように構成される燃料電池システムFCSの作用について述べる。液体原燃料FL(例えばメタノールと水の混合燃料)が、ポンプにより、液体原燃料貯蔵タンクTから燃料蒸発器1に所定量供給される。燃料蒸発器1の蒸発器本体10に供給された液体原燃料FLは、原燃料噴射装置40により蒸発器本体10の蒸発室11内に設けられたU字形の熱媒チューブ12の外表面に噴射される。前記蒸発室11内の前記熱媒チューブ12には、熱媒チューブ12の内側に設けられた触媒燃焼部14で、燃料電池5の水素極のオフガスOGを燃焼して発生した高温熱媒体である燃焼ガスHGが流れおり、前記液体原燃料FLは、熱媒チューブ12を介して前記燃焼ガスHGから得られる熱により蒸発室11内で原燃料ガスFGとして蒸発される。蒸発器本体10の加熱源としては、運転時は、熱媒チューブ12内の触媒燃焼部14で燃料電池5の水素極のオフガスOGや補助燃料を燃焼して触媒燃焼することで発生する燃焼ガスHGを使用するが、起動時等で加熱源がない場合は、燃焼バーナ7で補助燃料(例えばメタノール)を燃焼して必要熱量を確保できるようになっている。

【0014】前記蒸発器本体10で発生した原燃料ガスFGは、過熱部30で凝縮しない温度まで過熱されて改質器2に導入され、改質器2に導入された原燃料ガスFGは、固体触媒(例えばCu-Zn系の触媒)上で反応させて水素リッチな燃料ガスを製造する。さらに、改質器2で生成された水素リッチな燃料ガスは、ガス中の一酸化炭素をCO除去器3で除去された後、前記CO除去器3から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機4により圧縮された空気中の酸素とを反応させて発電を行う燃料電池5に導入される。燃料電池5で反応した後の水素極のオフガスOGは、気液分離装置6で水分を分離・除去された後、再び触媒燃焼部14で燃焼されて蒸発器本体10の加熱源となる。なお、蒸発器本体10で発生した原燃料ガスFGが充分に凝縮しない熱量を有していれば過熱器30を通過する直接改質器2に導入しても良い。

【0015】以下、図2乃至図5を参照して本発明に係る燃料蒸発器1の実施形態について詳細に説明する。本発明に係る燃料蒸発器1は、被燃焼体である燃料電池5の水素極のオフガスOGを導入する燃料蒸発器1の入口部21と、前記入口部21に連設し、その内側に、前記オフガスOGの大部分を通して触媒燃焼させる触媒燃焼部14を有し、前記触媒燃焼部14から発生する高温熱媒体である燃焼ガスHGにより、外表面で接触する液体原燃料FLを蒸発させるU字形をした熱媒チューブ12と、前記熱媒チューブ12を保持するチューブ保持部16と、前記熱媒チューブ12および前記チューブ保持部16を囲んだ部屋である蒸発室11と、前記蒸発室11

の上部に設けられ、液体原燃料FLを前記蒸発室11内に噴射する原燃料噴射装置40とから構成される蒸発器本体10と、前記蒸発室11内で液体原燃料FLを蒸発させた後の燃焼ガスHGが、蒸発室11の側部を保温するように蒸発室11の周囲に設けられた高温熱媒体通路である燃焼ガス通路13、17、18、19と、前記蒸発室11の下面10Aに隣接して設けられ、前記オフガスOGの残分を触媒燃焼させた高温熱媒体である燃焼ガスHG1により蒸発室11底部の液体原燃料FLを蒸発させる触媒燃焼器20と、前記燃焼ガスHG1と前記燃焼ガス通路13、18を通った燃焼ガスHGとが合流した高温熱媒体である燃焼ガスHG2により原燃料ガスFGを過熱する図示しない過熱部30と、から主要部が構成される。

【0016】次に、本発明に係る燃料蒸発器1の作用について図2を参照して説明する。被燃焼体である燃料電池5の水素極のオフガスOGは、燃料蒸発器1の入口部21を通って、チューブ保持部16に保持されたU字形の熱媒チューブ12の入口部12aで2つの流れに分岐する。

【0017】分岐したうちの1つの流れは、図2に示すように、そのまま熱媒チューブ12の入口部12aに設けられた触媒燃焼部14へと流れ、オフガスOGを燃焼して高温熱媒体である燃焼ガスHGを生成し、生成した高温の燃焼ガスHGは、蒸発室11内に設けられたU字形の熱媒チューブ12内を下から上へと流れる。前記燃焼ガスHGは、蒸発室11内のU字形をした熱媒チューブ12内を通るときに、前記熱媒チューブ12の外表面へ原燃料噴射装置40により噴射される液体原燃料FLを燃焼ガスHGの保有熱で蒸発させ、原燃料ガスFGを生成する。次に、液体原燃料FLを蒸発した後の燃焼ガスHGは、熱媒チューブ12の出口12bから燃焼ガス通路13に排出され、図5に示すように、蒸発室11の周りを囲むようにして設けられた燃焼ガス通路13、18を経由して、燃焼ガス通路17において触媒燃焼器20で発生した高温熱媒体である燃焼ガスHG1と合流する。さらに合流した高温熱媒体である燃焼ガスHG2は、燃焼ガス通路19および出口部22を通って過熱部30(図1参照)へと導かれ、蒸発室11内で蒸発した原燃料ガスFGを凝縮しない温度まで過熱する。

【0018】一方、分岐したうちのもう1つの流れは、図2に示すように、蒸発室11の下面10Aに隣接して設けられ、長方形の断面形状をした触媒燃焼器20の入口部20aへと流れ、装填された触媒でオフガスOGを燃焼することにより触媒燃焼器の出口20bから高温熱媒体である燃焼ガスHG1を発生する。触媒燃焼器20で発生した燃焼ガスHG1は、蒸発室11底部の液体原燃料FLを蒸発した後、図5に示すように、蒸発室11から排出された燃焼ガスHGと燃焼ガス通路17で合流し、合流した燃焼ガスHG2は、燃焼ガス通路19、2

2を通って蒸発室11の後段に設けられる図示しない過熱部30へと導かれる。過熱部30を出た燃焼ガスHG2は、排ガスとして系外に排出され、過熱された原燃料ガスFGは改質器2へと導入される。

【0019】次に、本発明に係る燃料蒸発器1の熱媒チューブ12に設けられる触媒燃焼部14について図3を参照して詳細に説明する。触媒燃焼部14は、燃料蒸発器1の蒸発室11内の熱媒チューブ12の内側に従来の触媒燃焼器の触媒と同じ触媒を装填して触媒燃焼器と燃料蒸発器を一体化したものである。第一実施形態の触媒燃焼部14の構造は、図3(a)に示すように、格子状のハニカム触媒14aを熱媒チューブ12内に装填したものである。図3(a)では触媒セルの形状が4角形を示しているが6角形のものでも良い。ハニカム触媒14aの製法としては、通常、セラミックス担体表面にアルミニウムや酸化ジルコニアなど比表面積の大きな担体を被覆し、その上に白金その他の活性成分を含浸する方法で触媒が調製される。ハニカム触媒14aは、担体に触媒活性成分を担持したものを熱媒チューブ12に装填してもよいし、最初にハニカム担体のみを装填し、熱媒チューブ12の内面およびハニカム担体に後から触媒活性成分を担持させるように調製しても良い。ハニカム触媒14aは、オフガスOGと触媒活性成分との接触面積および触媒内のガスの線速度を大きくとれるので、ダスト等の固体粒子を多く含んだガスを流したときよりも対しては、固定床用の粒状触媒を装填したときよりも寿命が長い。ハニカム触媒14aの担体の材質は、セラミックスとしてはコーディエライト( $2\text{MgO}-\text{Al}_2\text{O}_3-5\text{SiO}_2$ )、ムライト( $3\text{Al}_2\text{O}_3-2\text{SiO}_2$ )等が良く使用されているが、金属も担体として使用できる。前記ハニカム担体は、主として高流速条件下での圧力損失、および熱履歴による触媒の粉化を防ぐ目的で使用される蜂の巣状に押し出し成型された担体である。ハニカム担体は、比活性の高い貴金属触媒(例えば白金)を少量(ハニカム担体の重量をも含めた全触媒量に対して1%以下)担持するのに適している。

【0020】第二実施形態の触媒燃焼部14の構造は、図3(b)に示すように、平板状フェライト系ステンレスPLと同じ素材の波板WPとをろう付け加工した触媒セルを交互に渦巻き状に巻き回したハニカム体からなり、それをステンレス製(例えばSUS316L)の熱媒チューブ12内に装填したものである。平板状フェライト系ステンレスPLと波板WPの間および前記ハニカム体と熱媒チューブ12の間は、耐熱性の高いNiろう材により接合される。波板WPを設けたハニカム体とすることで燃料電池5のオフガスOGと触媒活性成分との接触面積を大きくすることができ、平板PLで波板WPの上下を挟むように巻き回したことで、熱媒チューブ12内に装填するときに、波板WPにかかる偏荷重による変形を防止できる。触媒は、金属担体に触媒活性成分を

担持したものを熱媒チューブ12に装填してもよいし、最初に金属担体のみを装填し、熱媒チューブ12の内面および前記金属担体に後から触媒活性成分を担持させるように調製しても良い。

【0021】第三実施形態の触媒燃焼部14の構造は、図示しないが、1枚の長方形の板を捻った形状の捻れフィンの担体に金属活性成分を担持した捻れフィン触媒を、蒸発室11内の熱媒チューブ12内に装填したものである。このようにすることにより、捻れフィンにより熱媒チューブ12内の触媒燃焼部14で発生した燃焼ガスHGの流れを乱流化することができる。乱流化することにより、熱媒チューブ12内の半径方向の温度分布がなくなり伝熱係数が大きくなるので、触媒燃焼部14で発生させた燃焼ガスHGの保有熱量が、蒸発器本体10の蒸発室11内における液体原燃料FLの蒸発に有效地に利用できる。従って、液体原燃料FLの蒸発を促進することができる。触媒は、金属担体に触媒活性成分を担持したものを熱媒チューブ12に装填してもよいし、最初に金属担体のみを装填し、熱媒チューブ12の内面および前記金属担体に後から触媒活性成分を担持させるように調製しても良い。

【0022】次に、蒸発室10の下面10Aに隣接して設けられる触媒燃焼器20の構造について図4を参照して説明する。触媒燃焼器20は、燃料電池5の水素極から排出されるオフガスOGを触媒燃焼して発生した燃焼ガスにより蒸発室11の下面10Aから蒸発室11を加熱・保温するための設備であり、蒸発室11の下面10Aに隣接して好ましくは密着して設けられる。第一実施形態の触媒燃焼器20の構造は、図4(a)に示すように、触媒セルの断面形状が、波板WP1の上下を平板PL1で挟んだ形状をしており、断面形状が長方形の配管の中に前記触媒セルを積層して装填したものである。このように、触媒燃焼器20の断面形状を長方形とすることにより、蒸発室10の下面10Aと触媒燃焼器20との接触面積(伝熱面積)を最大限に大きくできるので、触媒燃焼器20で発生した高温熱媒体である燃焼ガスHG1の保有熱量を蒸発室10の下面10Aに有効に伝えることができる。また、触媒活性の高い触媒を使用すればさらに触媒燃焼器20の高さを小さくできる。従って、車両に燃料電池システムFCSを搭載したときの車高を低くできる。

【0023】第二実施形態の触媒燃焼器20の構造は、図4(b)に示すように、触媒セルの断面形状が、図4(a)と同様な波板の上下を平板で挟んだ断面形状をしており、円筒形の配管中に前記触媒セルをドーナツ状(同心円状)に積層して装填した後、上下から円筒形の配管を潰して配管の上下に平坦部を形成した横長の長円形をしている。このような構造とすることにより、蒸発室10の下面10Aとの接触面積(伝熱面積)を円筒形の配管に触媒を装填したときよりも大きくすることができます。

き、触媒燃焼器20で発生した高温熱媒体である燃焼ガスHG1の保有熱量を、蒸発室11底部の液体原燃料FLの蒸発に有效地に利用できる。

【0024】第三実施形態の触媒燃焼器20の構造は、図4(c)に示すように、第二実施形態の触媒燃焼器20の上面をカットして、上に平板を溶接付けした横長の半長円形をしている。このような構造にすれば、第二実施形態の触媒燃焼器20よりもさらに蒸発室11の下面10Aとの接触面積(伝熱面積)を大きくでき、触媒燃焼器20で発生した燃焼ガスHG1の保有熱量を蒸発室11底部の液体原燃料FLの蒸発に有效地に利用できる。

【0025】第四実施形態の触媒燃焼器20の構造は、図示しないが、第一実施形態の触媒燃焼器(図4(a)参照)と同様な断面形状が長方形の中空配管の内側に、図3(a)の第一実施形態の触媒燃焼部または図3(b)の第二実施形態の触媒燃焼部である触媒を装填した円筒形の配管を水平方向に並列配置したものである。水平方向に配置することにより、蒸発室11の底面と触媒燃焼器との接触面積(伝熱面積)を最大限大きくでき、並列配置することで触媒燃焼器の高さを高くしないで処理能力をアップすることができる。その結果、触媒燃焼器20の高さを低くでき、限られたスペースでも効率的な燃料蒸発器1の構成が可能となる。

【0026】次に、本発明に係る燃料蒸発器1内の燃焼ガスが流れる高温熱媒体通路である燃焼ガス通路13, 17, 18, 19について図2(a)および図5を参照して説明する。燃焼ガス通路13, 17, 18, 19は、蒸発器本体10の蒸発室11の周囲に設けられ、蒸発室11を加熱・保温するために設けられる高温熱媒体である燃焼ガスHG, HG1, HG2の通路である。燃料電池5の水素極の被燃焼体であるオフガスOGは、燃料蒸発器1の入口部21で2つの流れに分岐する。1つの流れは、熱媒チューブ12の入口部12aに設けられた触媒燃焼部14を通って高温の燃焼ガスHGを発生し、蒸発室11内で液体原燃料FLを蒸発した後、熱媒チューブ12の上方の出口部12bから燃焼ガス通路13に排出される。排出された燃焼ガスHGは、燃料蒸発器1の手前に設けられた燃焼ガス通路18、左側面に設けられた燃焼ガス通路17を通過する。もう1つの流れは、蒸発室10の下面10Aに隣接して設けられた触媒燃焼器20を通って燃料蒸発器1の裏側から上昇して前記燃焼ガス通路17に排出される。燃焼ガス通路17に排出された高温熱媒体である燃焼ガスHG1は、前記燃焼ガス通路18からの高温熱媒体である燃焼ガスHGと合流し、合流した高温熱媒体である燃焼ガスHG2は、燃焼ガス通路19および出口部22を通って過熱部30へと導入され原燃料ガスFGを過熱する。過熱された原燃料ガスFGは改質器2へと導入され、燃焼ガスHG2は、排ガスとして系外に排出される。

【0027】このように、熱媒チューブ12の内側に設

けた触媒燃焼部14から排出される燃焼ガスHGおよび蒸発室11の下面10Aに設けた触媒燃焼器20から排出される燃焼ガスHG1を、蒸発室の加熱・保温ができるように高温熱媒体通路である燃焼ガス通路13, 17, 18, 19を設けて蒸発室11の周囲に通流させることにより、燃焼ガスHG, HG1, HG2の保有熱量を蒸発室11に与え、蒸発室11内における液体原燃料FLの速やかな蒸発にさらに有效地に利用できる。

【0028】以上述べたように、燃料蒸発器1の蒸発室11内の熱媒チューブ12の内側に、触媒燃焼反応により被燃焼体であるオフガスOGを燃焼させる触媒燃焼部14を設け、触媒燃焼器と燃料蒸発器を一体化した構成とすることに燃料蒸発器全体の高さを小さくできる。また、一体化することにより、従来問題となっていた触媒燃焼器から燃料蒸発器の熱媒チューブ12までの配管から系外への熱損失がなくなる。さらに蒸発室11の下面10Aに隣接するように触媒燃焼器20を設け、前記蒸発室11の周囲には高温熱媒体通路である燃焼ガス通路13, 17, 18, 19を配設する構成としたことにより、燃料蒸発器1の高さHを低くすることができ、かつ、熱媒チューブ12の内側に設けた触媒燃焼部14および蒸発室11の下面に設けた触媒燃焼器20で発生した燃焼ガスHG, HG1の保有熱量を有效地に利用することができる燃焼ガス通路13, 17, 18, 19を備えた燃料蒸発器1を提供することができる。

【0029】

【発明の効果】以上の構成と作用から明らかなように、本発明によれば、

1) 蒸発室内の熱媒チューブの内側に、触媒燃焼反応により被燃焼体を燃焼させる触媒燃焼部を設けて、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、従来、燃料蒸発器の前段に設けられていた触媒燃焼器の設置スペースを不要とし、燃料蒸発器全体の高さを小さくできる。その結果、特に車両に燃料電池システムを搭載したときの車高を小さくすることができる。また、触媒燃焼器と燃料蒸発器を一体化した構成とすることにより、触媒燃焼器から燃料蒸発器の熱媒チューブまでの配管から系外への熱損失がなくなる。

2) 蒸発室の下面に触媒燃焼器を隣接するように設けて、蒸発室の加熱・保温用の高温熱媒体を発生させ、蒸

発室の熱媒チューブ内の触媒燃焼部で発生した高温熱媒体を蒸発室の周囲に設けた高温熱媒体通路に通流させて、さらに蒸発室を加熱・保温することにより、速やかに蒸発が行われる。従って、触媒燃焼器および高温熱媒体通路を設けない場合と比較して、触媒燃焼器でのオフガスを燃焼する量を少なくできるので、触媒装填量を減らすことができる。その結果、触媒燃焼器の高さを低くでき、全体として燃料蒸発器をコンパクト化することができる。

10 【図面の簡単な説明】

【図1】本発明に係る燃料電池システムの全体系統図である。

【図2】(a)は、本発明に係る燃料蒸発器の側断面図である。(b)は、図2(a)のX-X'断面図である。(左半分省略)。

【図3】(a)本発明に係る触媒燃焼部の第一実施形態を示す横断面の斜視図である。

(b)本発明に係る触媒燃焼部の第二実施形態を示す横断面の斜視図である。

20 【図4】(a)本発明に係る触媒燃焼器の第一実施形態を示す横断面の斜視図である。

(b)本発明に係る触媒燃焼器の第二実施形態を示す横断面の斜視図である。

(c)本発明に係る触媒燃焼器の第三実施形態を示す横断面の斜視図である。

【図5】本発明に係る燃料蒸発器の燃焼ガス通路を示す斜視図である。

【図6】従来の燃料蒸発器の側断面図である。

【符号の説明】

30 1 燃料蒸発器

10 蒸発器本体

11 蒸発室

12 熱媒チューブ

13, 17, 18, 19 燃焼ガス通路(高温熱媒体通路)

14 触媒燃焼部

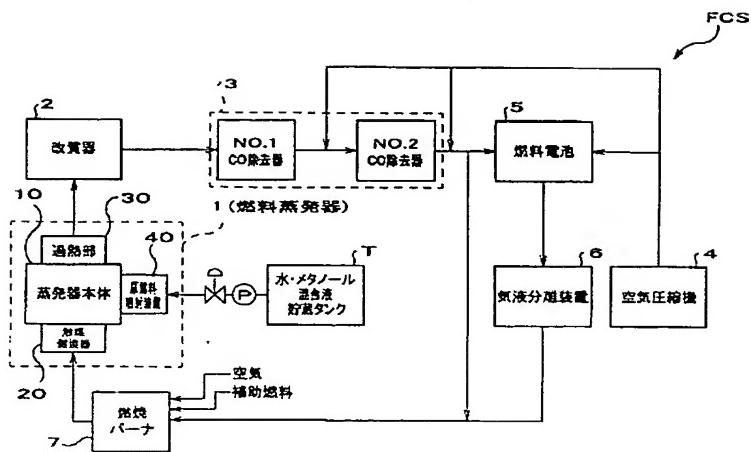
20 触媒燃焼器

30 過熱部

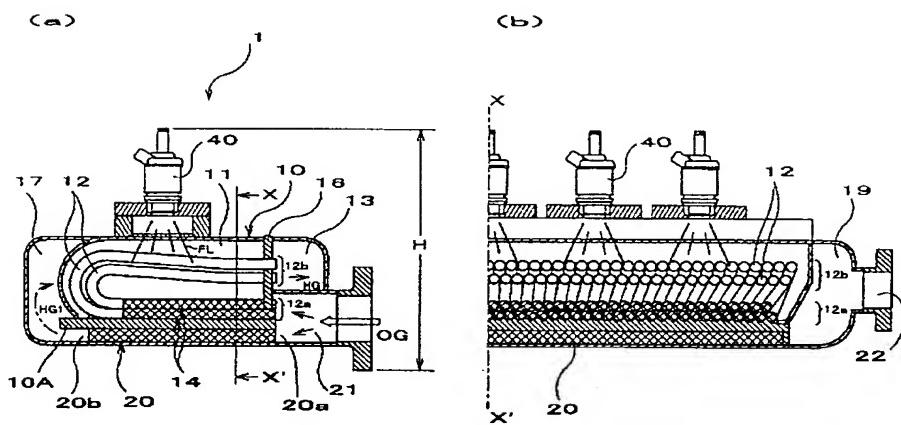
H 燃料蒸発器の高さ

40 HG, HG1, HG2 燃焼ガス(高温熱媒体)

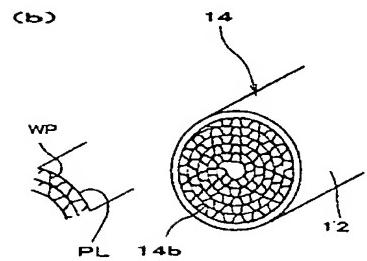
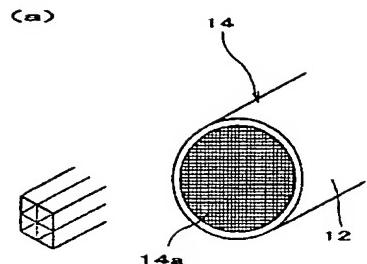
【図1】



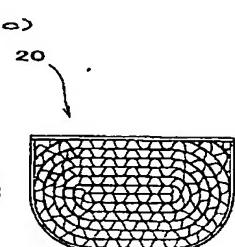
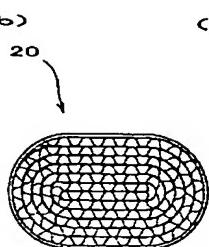
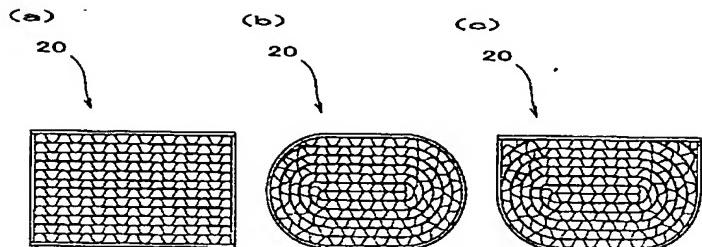
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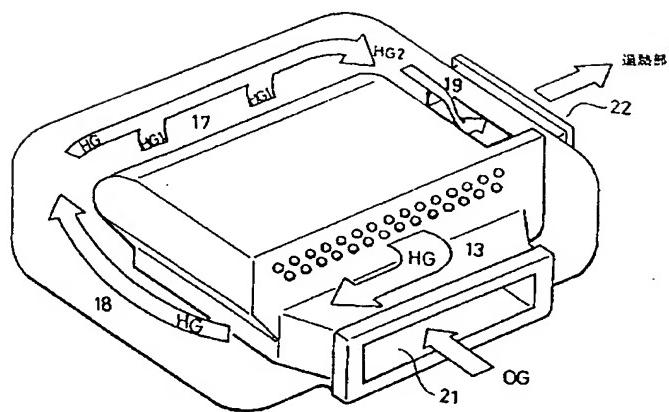
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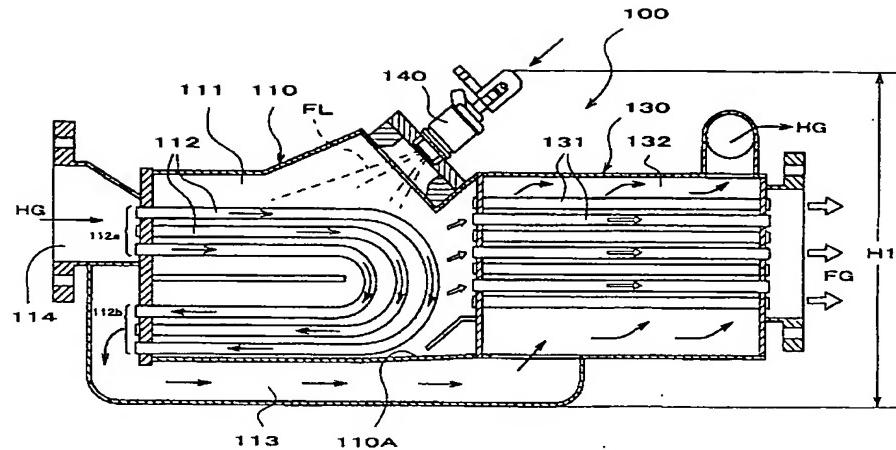
〔図4〕



〔図5〕



[図6]



フロントページの続き

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**\* NOTICES \***

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**Bibliography**

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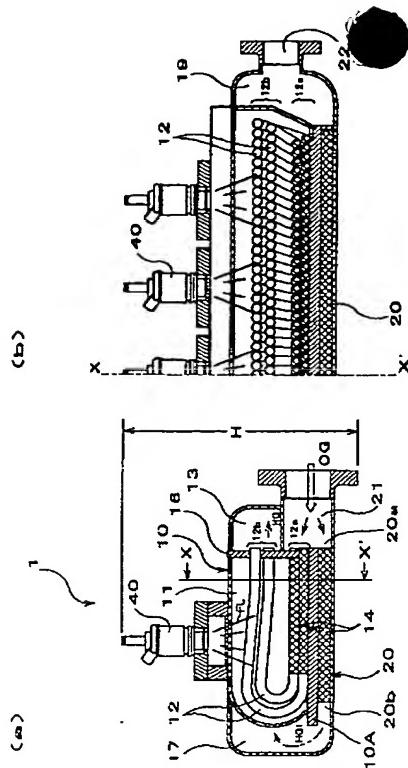
(57) [Abstract]

[Technical problem] It aims at offering the fuel evaporator which can make the height of a fuel evaporator low and can lessen heat loss from piping of the heating medium for higher temperature which carried out catalyzed combustion and was generated to the outside of a system.

[Means for Solution] Let the fuel evaporator characterized by having the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass, and having the catalyzed combustion section 14 which burns the burned body into said thermal tube 12 in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube be a solution means.

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#### CLAIMS

##### [Claim(s)]

[Claim 1] The fuel evaporator characterized by having the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass, and having the catalyzed combustion section which burns the burned body into said thermal tube in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube.

[Claim 2] The fuel evaporator according to claim 1 characterized by equipping the part except said evaporation chamber having adjoined the catalyzed combustion machine contiguous to said evaporation chamber with the heating-medium-for-higher-temperature path as for which said heating medium for higher temperature after evaporating said liquid Hara fuel carries out conduction.

[Translation done.]

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Field of the Invention]** This invention relates to the fuel evaporator equipped with the catalyzed combustion section which burns the burned body inside the thermal tube of the evaporation interior of a room in more detail about the fuel evaporator of the liquid Hara fuel in a fuel cell system.

**[0002]**

**[Description of the Prior Art]** A fuel cell system is a generation-of-electrical-energy system which made the nucleus the fuel cell which generates electricity by supplying the oxidation gas containing oxygen to the oxygen pole (anode plate) of a fuel cell while supplying it to the hydrogen pole (cathode) of a fuel cell by making hydrogen into fuel gas. This fuel cell system transforms chemical energy into direct electrical energy, and since there are very few discharges of having high generating efficiency or harmful matter, it attracts attention recently.

**[0003]** The fuel evaporator used by the conventional fuel cell system is indicated by Japanese Patent Application No. No. 125366 [ 11 to ]. The inlet-port section 114 for this fuel evaporator 100 to introduce into the body 110 of an evaporator the combustion gas HG which is the heating medium for higher temperature generated by burning the burned body in catalytic reaction in the catalyzed combustion machine, as shown in drawing 6 , Conduction of said combustion gas HG is carried out to the inside from inlet-port section 112a of the thermal tube 112 of U typeface to outlet section 112b. With the evaporation chamber 111 which makes it evaporate with the heat which can obtain the liquid Hara fuel floor line injected by the outside surface of said thermal tube 112 from the original fuel injection equipment 140 from said combustion gas HG The combustion gas path 113 established in inferior-surface-of-tongue 110A of an evaporation chamber 111 in which said combustion gas HG after evaporating the liquid Hara fuel floor line carries out conduction, The principal part consists of hot spots 130 formed from the overheating room 132 and the steamy tube 131 for overheating the original fuel gas FG which evaporated in said evaporation chamber 111 by the combustion gas HG which went via said combustion gas path 113.

**[0004]** As mentioned above, an operation of the conventional fuel evaporator 100 constituted is described. The combustion gas HG which is the heating medium for higher temperature which the burned body was burned and was generated with the catalyzed combustion vessel which is not illustrated is introduced into the inlet-port section 114 of the body 110 of an evaporator. The combustion gas HG introduced into the inlet-port section 114 passes from inlet-port section 112a in the thermal tube 112 which carried out U typeface in an evaporation chamber 111 to outlet section 112b from a top to the bottom, and evaporates the liquid Hara fuel floor line injected by the outside surface of said thermal tube 112 with the original fuel injection equipment 140 in an evaporation chamber 111. Next, combustion gas HG after evaporating said liquid Hara fuel floor line is led to the overheating room 132 of a hot spot 130 via the combustion gas path 113, and overheats further the original fuel gas FG which evaporated in the evaporation chamber 111 from the outside of the steamy tube 131. The overheated original fuel gas FG is introduced to the reforming machine which is not illustrated, and combustion gas HG after

overheating original fuel ~~gas~~ HG is discharged out of a system as ~~ex~~ ~~t~~ gas.

[0005] However, in order that the conventional fuel evaporator 100 might establish the combustion gas path 113 in inferior-surface-of-tongue 110A of the evaporation chamber 111 of the body 110 of an evaporator as shown in drawing 6 or might adjoin and form the catalyzed combustion machine which is not illustrated in inferior-surface-of-tongue 110A of an evaporation chamber 111, when the height H1 of the whole fuel evaporator 100 became high and a fuel cell system was carried in a car, it had the problem that a car height will become high. Moreover, when a catalyzed combustion machine was adjoined and formed in inferior-surface-of-tongue 110A of an evaporation chamber 111, there was a problem that the amount of potential heat of the hot combustion gas HG which there is heat loss to the outside of a system by the way (temperature-reduction  $\Delta T=20\text{--}30$  degree C), and occurred with the catalyzed combustion vessel with much trouble of piping from the outlet of a catalyzed combustion machine to the thermal tube 112 in an evaporation chamber 111 will become useless.

[0006]

[Problem(s) to be Solved by the Invention] This invention aims at offering the fuel evaporator which can be made in order to solve said technical problem, can make the height of a fuel evaporator low, and can lessen heat loss from piping of the heating medium for higher temperature which carried out catalyzed combustion and was generated to the outside of a system.

[0007]

[Means for Solving the Problem] The place which makes into the summary of invention indicated by claim 1 for solving said technical problem is characterized by to have the thermal tube which lets the heating medium for higher temperature which can evaporate a liquid Hara fuel pass, and to have the catalyzed combustion section which burns the burned body into said thermal tube in the fuel evaporator which has the evaporation chamber which evaporates said liquid Hara fuel with the heat obtained from said thermal tube.

[0008] By preparing the catalyzed combustion section which burns the burned body by the catalyzed combustion reaction inside the thermal tube of the evaporation interior of a room, and considering as the configuration which unified the catalyzed combustion machine and the fuel evaporator, conventionally, the installation tooth space of a catalyzed combustion machine provided for the preceding paragraph of a fuel evaporator is made unnecessary, and height H of the whole fuel evaporator can be made small. Consequently, the car height when carrying a fuel cell system in a car can be made small. Moreover, the heat loss from piping from a catalyzed combustion machine to the thermal tube of a fuel evaporator to the outside of a system is lost by considering as the unified configuration.

[0009] The place made into the summary of invention indicated by claim 2 for solving said technical problem is a fuel evaporator according to claim 1 characterized by equipping the part except said evaporation chamber having adjoined the catalyzed combustion machine contiguous to said evaporation chamber with the heating-medium-for-higher-temperature path as for which said heating medium for higher temperature after evaporating said liquid Hara fuel carries out conduction.

[0010] Evaporation is promptly performed by forming a catalyzed combustion machine so that the inferior surface of tongue of an evaporation chamber may be adjoined, making the heating-medium-for-higher-temperature path which formed the heating medium for higher temperature it not only generates the heating medium for higher temperature for heating / incubation of an evaporation chamber, but generated in the catalyzed combustion section in the thermal tube of the evaporation interior of a room in the perimeter of an evaporation chamber carry out conduction, and heating and keeping an evaporation chamber warm further. Therefore, since the amount which carries out catalyzed combustion of the off-gas can be lessened as compared with the case where the account of catalyzed combustion and a heating-medium-for-higher-temperature path are not prepared, the amount of catalyst loading can be reduced.

Consequently, the height of a catalyzed combustion machine can be made low and a fuel evaporator can be miniaturized as a whole.

[0011]

[Embodiment of the Invention] The gestalt of operation of the fuel evaporator concerning this invention is explained with reference to a drawing. The whole fuel cell system schematic diagram which drawing 1 requires for this invention, and drawing 2 (a) The sectional side elevation of the fuel evaporator concerning this invention and drawing 2 (b) The X-X' sectional view (left half abbreviation) of drawing 2 (a) and drawing 3 (a) The perspective view of the cross section showing the first operation gestalt of the catalyzed combustion section concerning this invention and drawing 3 (b) The perspective view of the cross section showing the second operation gestalt of the catalyzed combustion section concerning this invention and drawing 4 (a) The perspective view of the cross section showing the first operation gestalt of the catalyzed combustion machine concerning this invention and drawing 4 (b) The perspective view of the cross section showing the third operation gestalt of the catalyzed combustion machine which the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion machine concerning this invention and drawing 4 (c) require for this invention, and drawing 5 are the perspective views showing the combustion gas path of the fuel evaporator concerning this invention.

[0012] First, the whole fuel cell system FCS which starts this invention with reference to drawing 1 and drawing 2 is explained. The fuel cell system FCS carried in a car In the evaporation chamber 11 of the body 10 of an evaporator The fuel evaporator 1 equipped with the catalyzed combustion section 14 inside the thermal tube 12 of U typeface which evaporates said liquid Hara fuel floor line which carries out conduction of the combustion gas HG which is the heating medium for higher temperature which carried out catalyzed combustion of the off-gas OG of a fuel cell 5 to the inside, and was generated, and contacts by the outside surface, and said thermal tube 12, The reforming machine 2 which the original fuel gas FG which said liquid Hara fuel floor line was evaporated, and was generated with said fuel evaporator 1 is made to react on a solid-state catalyst, and makes it fuel gas, CO removal machine 3 from which the carbon monoxide in said fuel gas generated with said reforming vessel 2 is removed, The fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react, The vapor-liquid-separation equipment 6 which separates and removes moisture from the off-gas OG of the hydrogen pole of a fuel cell 5, It is constituted including the combustion burner 7 which has the supply line of the auxiliary fuel (for example, methanol) which generates the combustion gas HG which is the heating medium for higher temperature which burns Off-gas OG and the auxiliary fuel which are supplied from vapor-liquid-separation equipment 6, and serves as a source of heating of the fuel evaporator 1 in the time of starting etc.

[0013] An operation of the fuel cell system FCS constituted as mentioned above is described. Specified quantity supply of the liquid Hara fuel floor line (for example, composite fuel of a methanol and water) is carried out from liquid Hara fuel storage tank T with a pump at the fuel evaporator 1. The liquid Hara fuel floor line supplied to the body 10 of an evaporator of the fuel evaporator 1 is injected by the outside surface of the thermal tube 12 of U typeface prepared in the evaporation chamber 11 of the body 10 of an evaporator by the original fuel injection equipment 40. In said thermal tube 12 in said evaporation chamber 11, the combustion gas HG which is the heating medium for higher temperature which burned and generated the off-gas OG of the hydrogen pole of a fuel cell 5 in the catalyzed combustion section 14 prepared inside the thermal tube 12 is flowing, and said liquid Hara fuel floor line evaporates as original fuel gas FG in an evaporation chamber 11 with the heat obtained from said combustion gas HG through the thermal tube 12. As a source of heating of the body 10 of an evaporator, although the combustion gas HG which occurs by burning and carrying out catalyzed combustion of Off-gas OG and the auxiliary fuel of a hydrogen pole of a fuel cell 5 in the catalyzed combustion section 14 in the thermal tube 12 is used at the time of operation, when there is no source of heating at the time of starting etc., an auxiliary fuel (for example, methanol) is burned by the combustion burner 7, and a need heating value can be secured.

[0014] the original fuel gas FG which it was overheated to the temperature which is not condensed by the hot spot 30, and the original fuel gas FG which occurred by said body 10 of an

evaporator was introduced to the reforming machine 2, and was introduced into the reforming machine 2 is made to react on a solid-state catalyst (for example, catalyst of a Cu-Zn system) -- having -- hydrogen -- rich fuel gas is manufactured. furthermore, the hydrogen generated with the reforming vessel 2 -- after rich fuel gas is removed by CO removal machine 3 in the carbon monoxide in gas, it is introduced into the fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react. After the off-gas OG of the hydrogen pole after reacting with a fuel cell 5 is separated and removed by vapor-liquid-separation equipment 6 in moisture, it burns in the catalyzed combustion section 14 again, and serves as a source of heating of the body 10 of an evaporator. In addition, as long as it has the heating value which the original fuel gas FG which occurred by the body 10 of an evaporator does not fully condense, you may introduce into the direct reforming machine 2, without letting a superheater 30 pass.

[0015] Hereafter, the operation gestalt of the fuel evaporator 1 applied to this invention with reference to drawing 2 thru/or drawing 5 is explained to a detail. The inlet-port section 21 of the fuel evaporator 1 which introduces the off-gas OG of the hydrogen pole of a fuel cell 5 whose fuel evaporator 1 concerning this invention is the burned body, By the combustion gas HG which is the heating medium for higher temperature which forms successively in said inlet-port section 21, has the catalyzed combustion section 14 which carries out catalyzed combustion to the inside through said the greater part of off-gas OG, and is generated from said catalyzed combustion section 14 The thermal tube 12 which carried out U typeface which evaporates the liquid Hara fuel floor line which contacts by the outside surface, With the evaporation chamber 11 which is a room surrounding the tube attaching part 16 holding said thermal tube 12, and said thermal tube 12 and said tube attaching part 16 The body 10 of an evaporator which consists of original fuel injection equipments 40 which are formed in the upper part of said evaporation chamber 11, and inject the liquid Hara fuel floor line in said evaporation chamber 11, The combustion gas paths 13, 17, 18, and 19 whose combustion gas HG after evaporating the liquid Hara fuel floor line in said evaporation chamber 11 is the heating-medium-for-higher-temperature path established in the perimeter of an evaporation chamber 11 so that the flank of an evaporation chamber 11 might be kept warm, The catalyzed combustion machine 20 which evaporates the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis by the combustion gas HG1 which is the heating medium for higher temperature to which it is adjacently prepared in inferior-surface-of-tongue 10A of said evaporation chamber 11, and catalyzed combustion of the residue of said off-gas OG was carried out, the hot spot 30 which overheats original fuel gas FG by the combustion gas HG2 which is the heating medium for higher temperature with which said combustion gas HG1 and the combustion gas HG passing through said combustion gas paths 13 and 18 joined and which is not illustrated -- since -- the principal part is constituted.

[0016] Next, an operation of the fuel evaporator 1 concerning this invention is explained with reference to drawing 2 . The off-gas OG of the hydrogen pole of the fuel cell 5 which is the burned body passes along the inlet-port section 21 of the fuel evaporator 1, and branches with two flow by inlet-port section 12a of the thermal tube 12 of U typeface held at the tube attaching part 16.

[0017] As one of the branched flow is shown in drawing 2 , it flows to the catalyzed combustion section 14 prepared in inlet-port section 12a of the thermal tube 12 as it was, and Off-gas OG is burned, the combustion gas HG which is a heating medium for higher temperature is generated, and the generated hot combustion gas HG flows upwards the inside of the thermal tube 12 of U typeface prepared in the evaporation chamber 11 from the bottom. When it passes along the inside of the thermal tube 12 which carried out U typeface in an evaporation chamber 11, said combustion gas HG evaporates the liquid Hara fuel floor line injected by the original fuel injection equipment 40 to the outside surface of said thermal tube 12 with the potential heat of combustion gas HG, and generates original fuel gas FG. Next, combustion gas HG after evaporating the liquid Hara fuel floor line is discharged by the combustion gas path 13 from outlet 12b of the thermal tube 12, and as shown in drawing 5 , it joins the combustion gas HG1

which is the heating medium for higher temperature generated with catalyzed combustion vessel 20 at the combustion gas path 17 via the combustion gas paths 13 and 18 prepared as surrounded the surroundings of an evaporation chamber 11. The combustion gas HG2 which is the heating medium for higher temperature which furthermore joined is led to a hot spot 30 (refer to drawing 1) through the combustion gas path 19 and the outlet section 22, and is overheated to the temperature which does not condense the original fuel gas FG which evaporated in the evaporation chamber 11.

[0018] As shown in drawing 2, one flow which will be accept on the other hand while branch be adjoin and prepare in inferior surface of tongue 10A of an evaporation chamber 11, and generate the combustion gas HG1 which be a heating medium for higher temperature from outlet 20b of a catalyzed combustion machine by flow to inlet port section 20a of the catalyzed combustion machine 20 which carried out the rectangular cross section configuration, and burn Off-gas OG with the catalyst with which it be loaded. After the combustion gas HG1 which occurred with the catalyzed combustion vessel 20 evaporates the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis, as it is shown in drawing 5, it joins at the combustion gas HG and the combustion gas path 17 which were discharged from the evaporation chamber 11, and the combustion gas HG2 which joined is led to the hot spot 30 which is prepared in the latter part of an evaporation chamber 11 through the combustion gas paths 19 and 22 and which is not illustrated. The combustion gas HG2 which came out of the hot spot 30 is discharged out of a system as exhaust gas, and the overheated original fuel gas FG is introduced to the reforming machine 2.

[0019] Next, the catalyzed combustion section 14 prepared in the thermal tube 12 of the fuel evaporator 1 concerning this invention is explained to a detail with reference to drawing 3. The catalyzed combustion section 14 loads with the same \*\*\*\*\* as the catalyst of the conventional catalyzed combustion machine inside the thermal tube 12 in the evaporation chamber 11 of the fuel evaporator 1, and unifies a catalyzed combustion machine and a fuel evaporator. The structure of the catalyzed combustion section 14 of the first operation gestalt loads with grid-like honeycomb catalyst 14a into the thermal tube 12, as shown in drawing 3 (a). In drawing 3 (a), although the configuration of a catalyst cel shows four square shapes, the thing of six square shapes may be used. As a process of honeycomb catalyst 14a, support with big specific surface area, such as gamma-alumina and a zirconium dioxide, is covered to a ceramic carrier surface, and a catalyst is usually prepared by the approach of sinking in the active ingredient of platinum and others on it. Honeycomb catalyst 14a may load the thermal tube 12 with what supported the catalytic activity component to support, may load only with honeycomb support first, and it may prepare it so that the inside and honeycomb support of the thermal tube 12 may be made to support a catalytic activity component afterwards. Since honeycomb catalyst 14a can take the touch area of Off-gas OG and a catalytic activity component, and a large linear velocity of the gas within a catalyst, its life is longer than the time of loading with the granular catalyst for the fixed beds to plugging when passing the gas containing many solid content particles, such as dust. Although cordierite (2MgO-2aluminum2O<sub>3</sub>-5SiO<sub>2</sub>), a mullite (3aluminum2O<sub>3</sub>-2SiO<sub>2</sub>), etc. are well used as ceramics, a metal can also be used for the quality of the material of the support of honeycomb catalyst 14a as support. Said honeycomb support is the support which extruded the pressure loss under the high rate-of-flow conditions, and mainly in the shape of [ of the bee used in order to prevent powdering of the catalyst by the heat history ] a blow hole, and was cast. Honeycomb support is suitable for carrying out small quantity (it being 1% or less to total amount of catalysts also including weight of honeycomb support) support of the high precious metal catalyst (for example, platinum) of specific activity.

[0020] As shown in drawing 3 (b), the structure of the catalyzed combustion section 14 of the second operation gestalt consists of a honeycomb object which wound about around the curled form by turns the catalyst cel which carried out soldering processing of the corrugated plate WP of the same material as the plate-like ferrite system stainless steel PL, and loads with it into the thermal tube 12 made from stainless steel (for example, SUS316L). It is joined by heat-resistant high nickel wax material between the plate-like ferrite system stainless steel PL and a corrugated plate WP and between said honeycomb objects and thermal tubes 12. The touch area

of the off-gas OG of a fuel cell 5 and a catalytic activity component can be enlarged by considering as the honeycomb object which formed the corrugated plate WP, and by having wound about so that the upper and lower sides of a corrugated plate WP might be inserted by monotonous PL, when loading into the thermal tube 12, deformation by the unbalanced load concerning a corrugated plate WP can be prevented. A catalyst may load the thermal tube 12 with what supported the catalytic activity component to metal support, may load only with metal support first, and it may prepare it so that the inside and said metal support of the thermal tube 12 may be made to support a catalytic activity component afterwards.

[0021] Although the structure of the catalyzed combustion section 14 of the third operation gestalt is not illustrated, it loads the support of the torsion fin of the configuration where one rectangular plate was twisted with the torsion fin catalyst which supported the metal active ingredient into the thermal tube 12 in an evaporation chamber 11. thus, twist by carrying out -- flow of the combustion gas HG which occurred in the catalyzed combustion section 14 in the thermal tube 12 with the fin can be turbulent-flow-ized. Since temperature distribution radial [ in the thermal tube 12 ] are lost and a heat transfer coefficient becomes large by turbulent-flow-izing, the amount of potential heat of the combustion gas HG generated in the catalyzed combustion section 14 can use effective in evaporation of the liquid Hara fuel floor line in the evaporation chamber 11 of the body 10 of an evaporator. Therefore, evaporation of the liquid Hara fuel floor line can be promoted. A catalyst may load the thermal tube 12 with what supported the catalytic activity component to metal support, may load only with metal support first, and it may prepare it so that the inside and said metal support of the thermal tube 12 may be made to support a catalytic activity component afterwards.

[0022] Next, the structure of the catalyzed combustion machine 20 adjoined and prepared in inferior-surface-of-tongue 10A of an evaporation chamber 10 is explained with reference to drawing 4 . It is the facility for heating and keeping an evaporation chamber 11 warm from inferior-surface-of-tongue 10A of an evaporation chamber 11 by the combustion gas which carried out catalyzed combustion of the off-gas OG discharged from the hydrogen pole of a fuel cell 5, and occurred, and the catalyzed combustion machine 20 adjoins inferior-surface-of-tongue 10A of an evaporation chamber 11, it is stuck preferably and formed. The structure of the catalyzed combustion machine 20 of the first operation gestalt is carrying out the configuration where the cross-section configuration of a catalyst cel sandwiched the upper and lower sides of a corrugated plate WP 1 by monotonous PL1 as shown in drawing 4 (a), and a cross-section configuration carries out the laminating of said catalyst cel into rectangular piping, and loads with it. Thus, since the touch area (heating area) of inferior-surface-of-tongue 10A of an evaporation chamber 10 and the catalyzed combustion machine 20 can be enlarged to the maximum extent by making the cross-section configuration of the catalyzed combustion machine 20 into a rectangle, the amount of potential heat of the combustion gas HG1 which is the heating medium for higher temperature generated with the catalyzed combustion vessel 20 can be told effective in inferior-surface-of-tongue 10A of an evaporation chamber 10. Moreover, if the high catalyst of catalytic activity is used, the height of the catalyzed combustion machine 20 can be further made small. Therefore, the car height when carrying the fuel cell system FCS in a car can be made low.

[0023] As shown in drawing 4 (b), after the structure of the catalyzed-combustion machine 20 of the second operation gestalt is carrying out the cross-section configuration where of the cross-section configuration of a catalyst cel was monotonous, and sandwiched the upper and lower sides of the same corrugated plate as drawing 4 (a), carries out the laminating of said catalyst cel to the shape of a doughnut (the shape of a concentric circle) and loads with it into piping of a cylindrical shape, it crushes piping of a cylindrical shape from the upper and lower sides, and is carrying out the oblong ellipse of piping which formed the flat part up and down. By considering as such structure, a touch area (heating area) with inferior-surface-of-tongue 10A of an evaporation chamber 10 can be made larger than the time of loading piping of a cylindrical shape with a catalyst, and the amount of potential heat of the combustion gas HG1 which is the heating medium for higher temperature generated with the catalyzed combustion vessel 20 can be used effective in evaporation of the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris

ossis occipitalis.

[0024] As shown in drawing 4 (c), the structure of the catalyzed combustion machine 20 of the third operation gestalt cuts the top face of the catalyzed combustion machine 20 of the second operation gestalt, and is carrying out the oblong half-ellipse which turned welding attachment of the plate up. If it is made such structure, a touch area (heating area) with inferior-surface-of-tongue 10A of an evaporation chamber 11 can be further enlarged rather than the catalyzed combustion machine 20 of the second operation gestalt, and the amount of potential heat of the combustion gas HG1 which occurred with the catalyzed combustion vessel 20 can be used effective in evaporation of the liquid Hara fuel floor line of evaporation-chamber 11 pars basilaris ossis occipitalis.

[0025] Although the structure of the catalyzed combustion machine 20 of the fourth operation gestalt is not illustrated, it carries out the parallel arrangement of the piping of a cylindrical shape whose same cross-section configuration of the as the catalyzed combustion machine (refer to drawing 4 (a)) of the first operation gestalt loaded with the catalyst which is the catalyzed combustion section of the first operation gestalt of drawing 3 (a), or the catalyzed combustion section of the second operation gestalt of drawing 3 (b) at the inside of rectangular hollow piping horizontally, arranging horizontally -- the touch area (heating area) of the base of an evaporation chamber 11, and a catalyzed combustion machine -- the maximum -- it can do greatly, and a throughput can be raised without making the height of a catalyzed combustion machine high by making it a parallel arrangement. Consequently, the height of the catalyzed combustion machine 20 can be made low, and the configuration of the efficient fuel evaporator 1 is attained also in the limited tooth space.

[0026] Next, the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths where the combustion gas in the fuel evaporator 1 concerning this invention flows are explained with reference to drawing 2 (a) and drawing 5. The combustion gas paths 13, 17, 18, and 19 are paths of the combustion gas HG, HG1, and HG2 which is the heating medium for higher temperature which is formed in the perimeter of the evaporation chamber 11 of the body 10 of an evaporator, and is formed in order to heat and keep an evaporation chamber 11 warm. The off-gas OG which is the burned body of the hydrogen pole of a fuel cell 5 branches with two flow in the inlet-port section 21 of the fuel evaporator 1. After one flow generates hot combustion gas HG through the catalyzed combustion section 14 prepared in inlet-port section 12a of the thermal tube 12 and evaporates the liquid Hara fuel floor line in an evaporation chamber 11, it is discharged by the combustion gas path 13 from upper outlet section 12b of the thermal tube 12. The discharged combustion gas HG passes through the combustion gas path 18 prepared before the fuel evaporator 1, and the combustion gas path 17 established in the left lateral. Another flow goes up from the background of the fuel evaporator 1 through the catalyzed combustion machine 20 adjoined and formed in inferior-surface-of-tongue 10A of an evaporation chamber 10, and is discharged by said combustion gas path 17. The combustion gas HG1 which is the heating medium for higher temperature discharged by the combustion gas path 17 joins the combustion gas HG which is a heating medium for higher temperature from said combustion gas path 18, and the combustion gas HG2 which is the heating medium for higher temperature which joined is introduced through the combustion gas path 19 and the outlet section 22 to a hot spot 30, and overheats original fuel gas FG. The overheated original fuel gas FG is introduced to the reforming machine 2, and combustion gas HG2 is discharged out of a system as exhaust gas.

[0027] Thus, the combustion gas HG1 discharged from the catalyzed combustion machine 20 formed in inferior-surface-of-tongue 10A of the combustion gas HG discharged from the catalyzed combustion section 14 prepared inside the thermal tube 12, and an evaporation chamber 11 By forming the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths so that heating and incubation of an evaporation chamber can be performed, and making the perimeter of an evaporation chamber 11 carry out conduction The amount of potential heat of combustion gas HG, HG1, and HG2 is given to an evaporation chamber 11, and it can use still more effective in prompt evaporation of the liquid Hara fuel floor line in an evaporation chamber 11.

[0028] As stated above, the height of the whole fuel evaporator can be made small considering as the configuration which formed the catalyzed combustion section 14 which burns the off-gas OG which is the burned body by the catalyzed combustion reaction inside the thermal tube 12 in the evaporation chamber 11 of the fuel evaporator 1, and united the catalyzed combustion machine and the fuel evaporator with it. Moreover, the heat loss from piping from the catalyzed combustion machine which had become a problem conventionally to the thermal tube 12 of a fuel evaporator to the outside of a system is lost by unifying. By having formed the catalyzed combustion machine 20 so that inferior-surface-of-tongue 10A of an evaporation chamber 11 might furthermore be adjoined, and having considered as the configuration which arranges in the perimeter of said evaporation chamber 11 the combustion gas paths 13, 17, 18, and 19 which are heating-medium-for-higher-temperature paths Height H of the fuel evaporator 1 can be made low. The fuel evaporator 1 equipped with the combustion gas paths 13, 17, 18, and 19 which can use effectively the amount of potential heat of the combustion gas HG and HG1 which occurred with the catalyzed combustion vessel 20 formed in the inferior surface of tongue of the catalyzed combustion section 14 and the evaporation chamber 11 which prepared inside the thermal tube 12 can be offered.

[0029]

[Effect of the Invention] according to this invention , by prepare the catalyzed combustion section which burn the burn body by the catalyzed combustion reaction inside the thermal tube of the 1 evaporation interior of a room , and consider as the configuration which unified the catalyzed combustion machine and the fuel evaporator , conventionally , the installation tooth space of a catalyzed combustion machine provided for the preceding paragraph of a fuel evaporator be make unnecessary , and the height of the whole fuel evaporator can be make small so that clearly from the above configuration and operation . The car height when carrying a fuel cell system in the result, especially a car can be made small. Moreover, the heat loss from piping from a catalyzed combustion machine to the thermal tube of a fuel evaporator to the outside of a system is lost by considering as the configuration which unified the catalyzed combustion machine and the fuel evaporator.

2) Evaporation is promptly performed by making the heating-medium-for-higher-temperature path which prepared so that the inferior surface of tongue of an evaporation chamber might be adjoined in a catalyzed combustion machine, and formed the heating medium for higher temperature which was made to generate the heating medium for higher temperature for heating / incubation of an evaporation chamber, and was generated in the catalyzed combustion section in the thermal tube of the evaporation interior of a room in the perimeter of an evaporation chamber carry out conduction, and heating and keeping an evaporation chamber warm further. Therefore, since the amount which burns the off-gas in a catalyzed combustion machine can be lessened as compared with the case where a catalyzed combustion machine and a heating-medium-for-higher-temperature path are not prepared, the amount of catalyst loading can be reduced. Consequently, the height of a catalyzed combustion machine can be made low and a fuel evaporator can be miniaturized as a whole.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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**[Brief Description of the Drawings]**

[Drawing 1] It is the whole fuel cell system schematic diagram concerning this invention.

[Drawing 2] (a) is the sectional side elevation of the fuel evaporator concerning this invention. (b) is the X-X' sectional view of drawing 2 (a). (Left half abbreviation).

[Drawing 3] (a) It is the perspective view of the cross section showing the first operation gestalt of the catalyzed combustion section concerning this invention.

(b) It is the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion section concerning this invention.

[Drawing 4] (a) It is the perspective view of the cross section showing the first operation gestalt of the catalyzed combustion machine concerning this invention.

(b) It is the perspective view of the cross section showing the second operation gestalt of the catalyzed combustion machine concerning this invention.

(c) It is the perspective view of the cross section showing the third operation gestalt of the catalyzed combustion machine concerning this invention.

[Drawing 5] It is the perspective view showing the combustion gas path of the fuel evaporator concerning this invention.

[Drawing 6] It is the sectional side elevation of the conventional fuel evaporator.

**[Description of Notations]**

1 Fuel Evaporator

10 Body of Evaporator

11 Evaporation Chamber

12 Thermal Tube

13, 17, 18, 19 Combustion gas path (heating-medium-for-higher-temperature path)

14 Catalyzed Combustion Section

20 Catalyzed Combustion Machine

30 Hot Spot

H Height of a fuel evaporator

HG, HG1, HG2 Combustion gas (heating medium for higher temperature)

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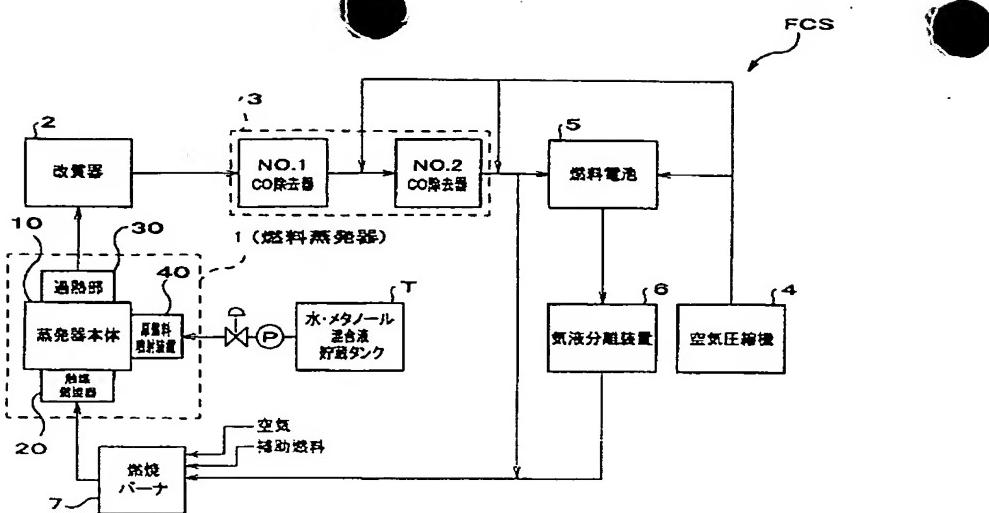
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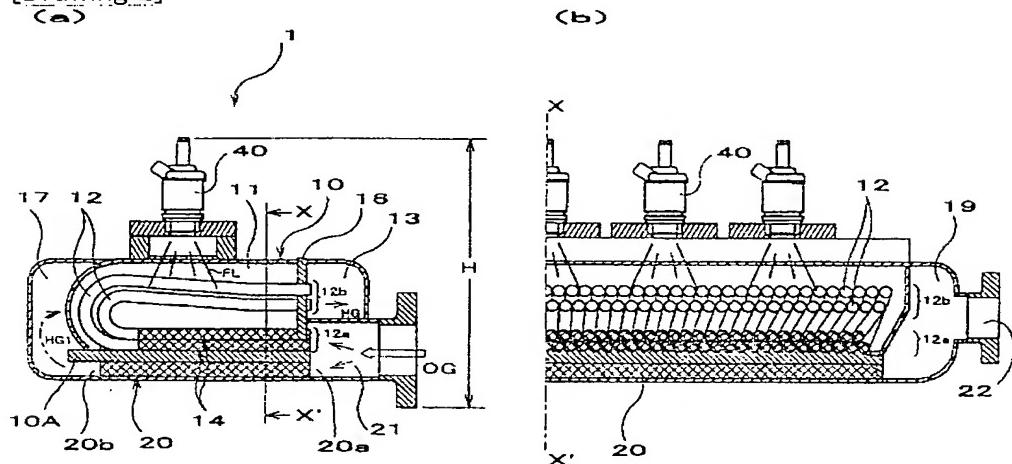
## DRAWINGS

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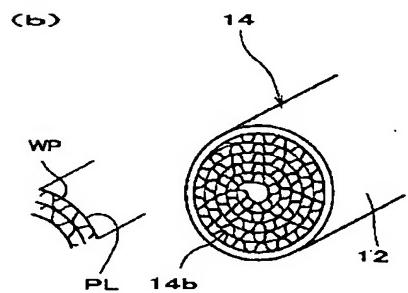
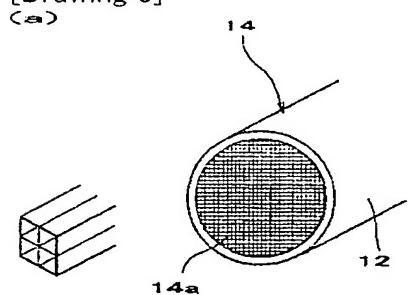
**[Drawing 1]**



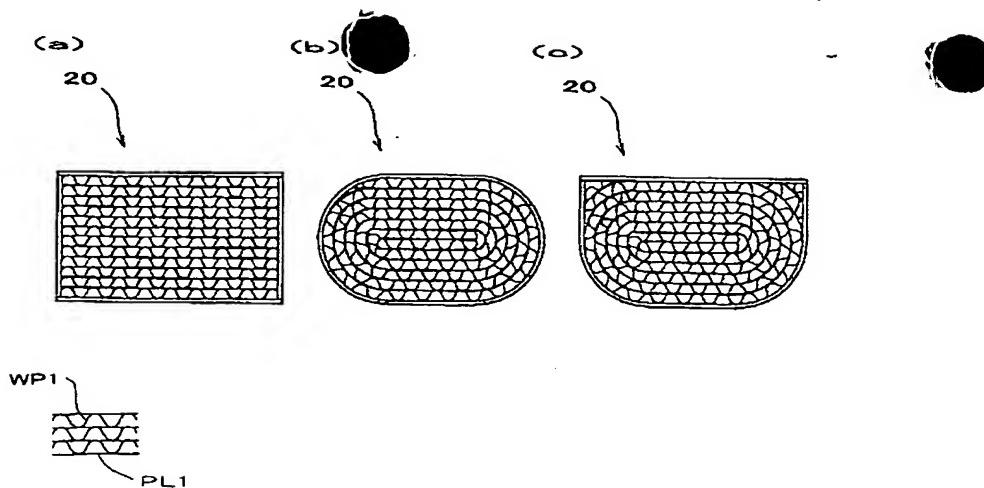
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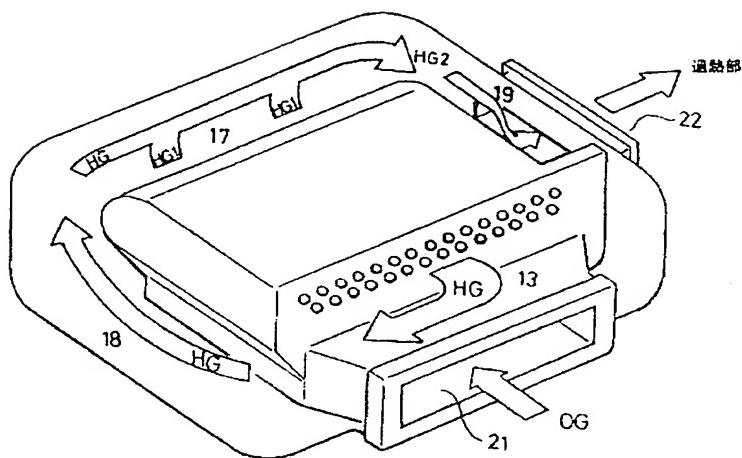
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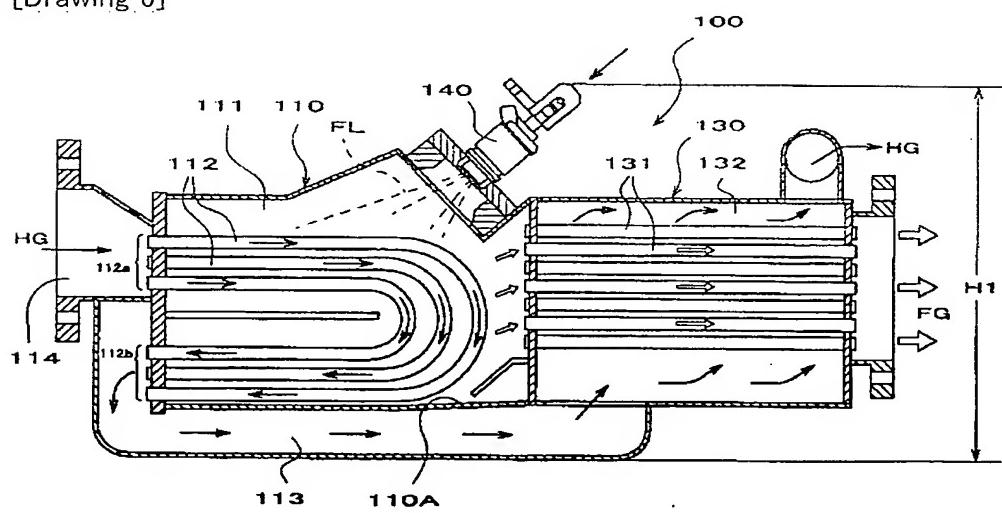
[Drawing 4]



[Drawing 5]



[Drawing 6]



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